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Measurement of the lag of accommodation by a cross-cylinder method

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Abstract

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MEASUREMENT OF THE LAG OF ACCOMMODATION BY A CROSS-CYLINDER METHOD

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OBJECTIVE OF THE FOLLOWING MATERIAL

To measure the lag of accommodation while the subject is looking at a 20/20 line of letters at a 16" testing distance.

EQUIPMENT

I. Four sphero-cylinders cut in half so as to produce eight split lenses. The lens powers of which are as follows:

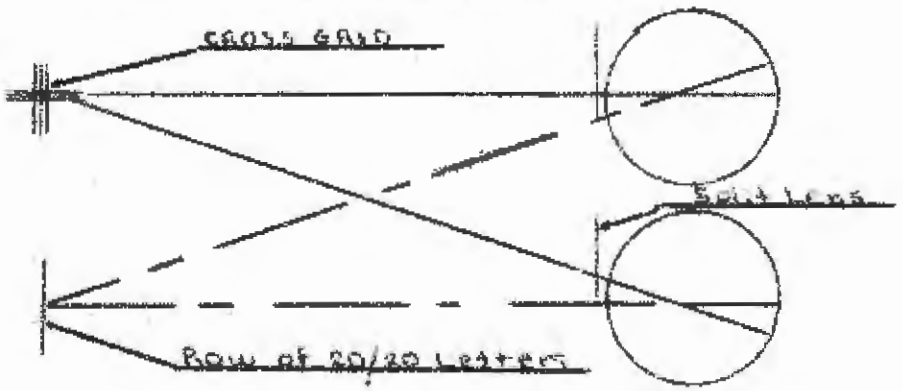
1. ∠ 0.25 - 1.00
2. - 0.25 - 1.00
3. - 0.50 - 1.00
4. - 0.75 - 1.00

II. A near point card with a single row of 20/20 letters, also a dark cross grid is imposed on this same card with a separation between the centers of the two figures of 44 mm.

III. A Bausch and Lomb Green phoropter.

PROCEDURE

The near point card was placed at 16" in front of the patients eyes, upon this card the effect of illumination was a constant 22 ft. candles for each subject. Number one split sphero-cylinder lens was placed in front of the phoropter and is diagramed as follows:



Thus creating a crossed cylinder at the spectacle plane.

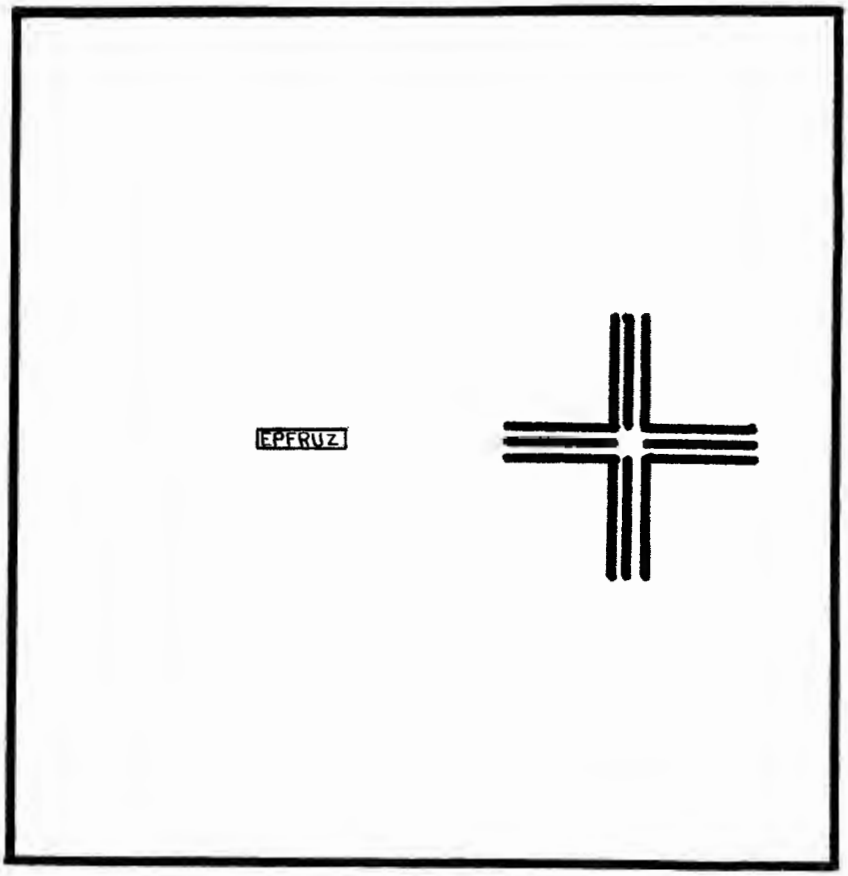
The subject was now told to adjust the phoropter so a single line was seen between the row of letters and the cross grid on the near point card. The single line would appear when the two half-lenses were at the same position in front of each eye.

The subjects prescription was now incorporated in the phoropter, this included his habitual cylindrical component. The following instructions were then given each subject.

"While reading the row of letters over and over to make sure you are accommodating at that point be aware of the cross grid but do not look directly at the grid". Plus lenses were now introduced binocularly in 0.25 diopter steps until the patient reported the letters were completly blurred. After reducing the plus lens 0.25 diopters, the subject was now asked to report as to which of the crossed lines were blacker, the horizontal or the vertical. This question was asked each time the plus lens was reduced by a 0.25 diopter until the subject reported the opposite lines were blacker. If this point was indistinguishable, the subject was told he could glance at the cross grid and back to the letters as fast as he could. The 0.25 diopter in-phoropter reading after equalization was the amount recorded. Minus lenses were now added

to 1.50 diopters below the last recorded finding and the same instructions were given as quoted above. Plus lenses are now added in 0.25 diopter steps until reversal again occurs. The lens at which the grids reverse was recorded.

The above procedure was repeated with lenses number 2, 3, and 4 and recorded as stated above.



The above is a reproduction of the testing target used for this experiment and the following are the measurements and angular deviation effective at the eye from both the cross and the row of letters.

Center of the near point card to the center of the cross is 28 mm. and the center of the near point card to the center of the letters is 16 mm.

The angular deveation at the eye from the center of the cross subtends an angle of 4 de-

grees 1 minute. The angular deveation at the eye from the center of the row of 20/20 letters subtends an angle of 2 degrees 17½ minutes. The vertical and horizontal lines of the cross are1 mm in width therefor subtend an angle of 8.5 minutes of arc, and the row of 20/20 letters subtend an angle of 4½ minutes of arc. These angles are calculated from a 16 inch distance.

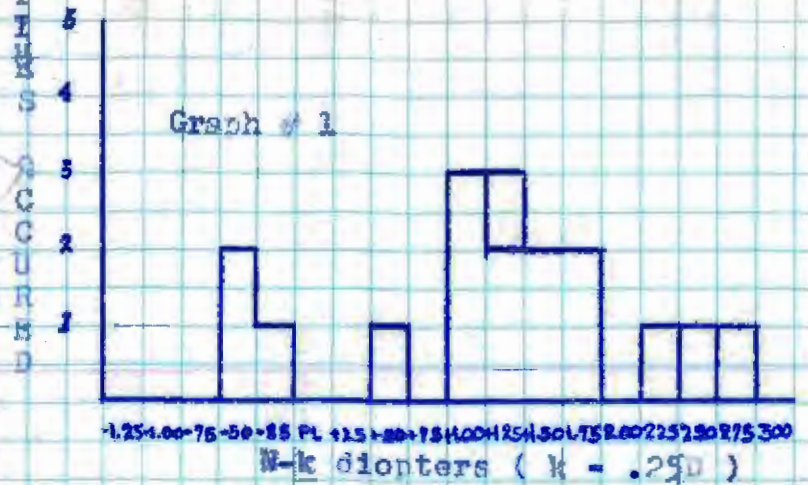
STATISTICAL DATA

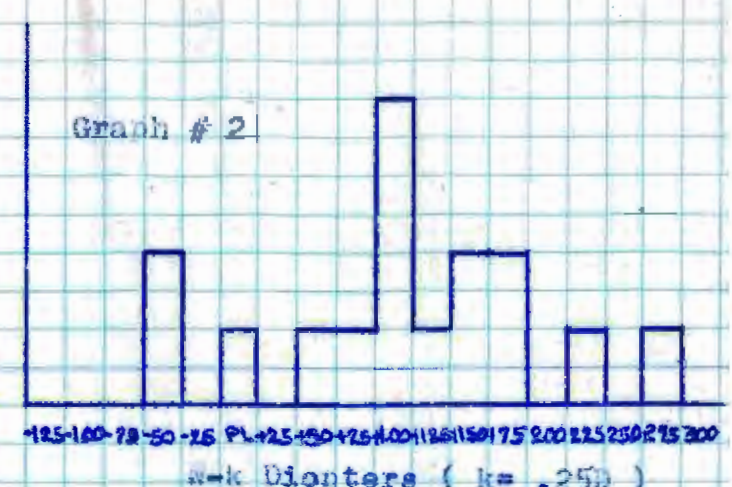
Sixteen subjects were used and the following is the statistical data acquired. Graphs number 1 through number 8 inclusive show the relationship of the findings through each cross-cylinder as compared to each other. The left hand column of graphs show the findings from the direction of greater plus and the right hand column shows the findings from the direction of lesser plus. The dioptric findings on the horizontal axis are the gross in-phoropter reading less the subjects habitual less a constant which changes the split lens power to a

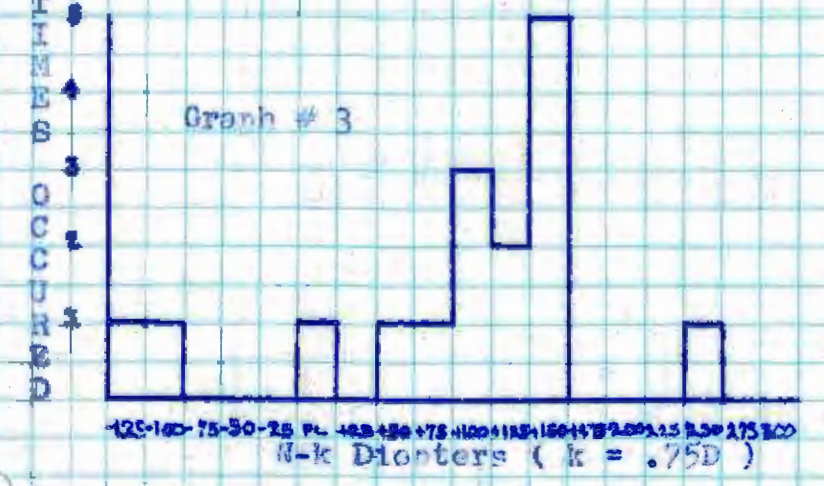
≠ 0.50 - 1.00 cross cylinder. Lens number one constant is equal to -.25 diopter; lens number two constant is equal to -.75 diopter; lens number three constant is - 1.00 diopter; and lens number 4 constant is equal to - 1.25 diopters; as can be determined by the graphs, the correlation between them is similar.

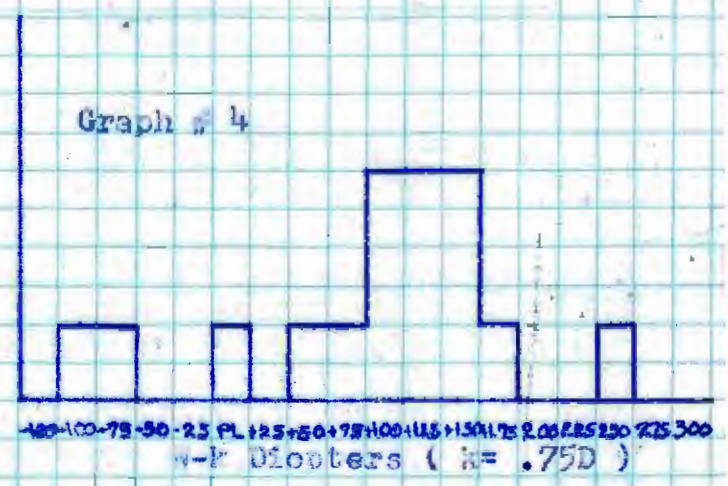
Graphs number 9 and number 10 show the combined distribution of the findings through all four lenses and graph number 11 shows the distribution of the minus and plus phase combined.

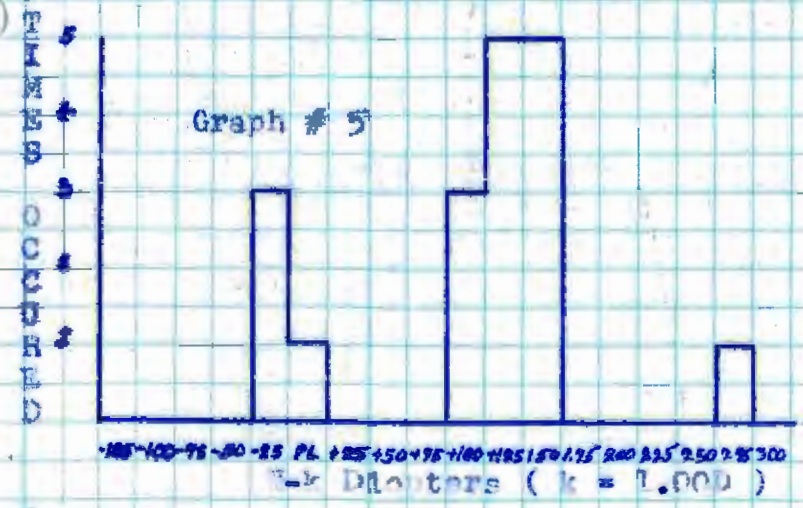
Table number I shows the calculation of the mean, mode, median, sigma, and sigma of the mean for each of the above mentioned graphs.

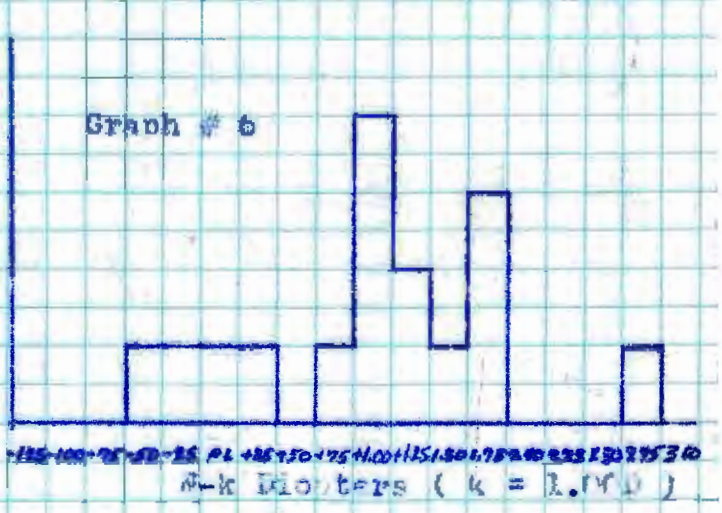

TIMES OCCURRED
Graph # 1
N-k dionters (k = .25D)

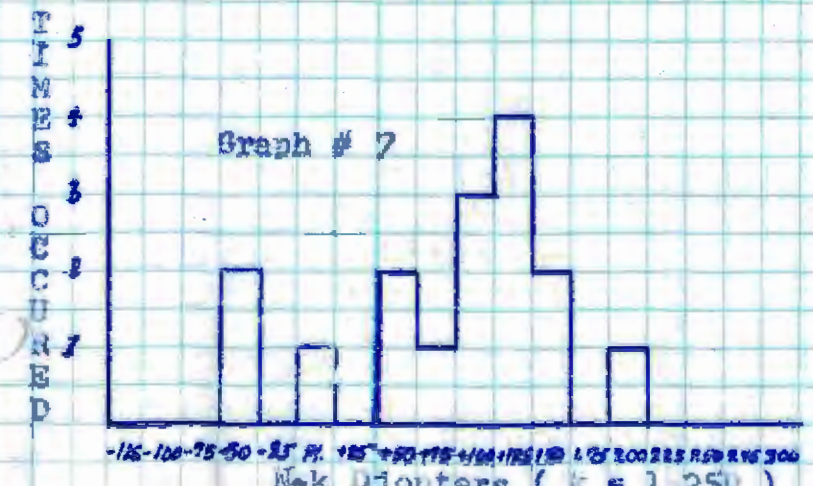

Graph # 2
N-k Dionters (k= .25D)

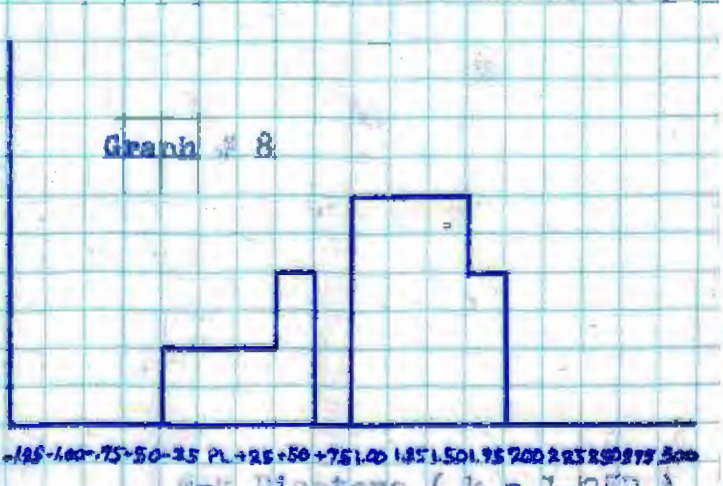

TIMES OCCURRED
Graph # 3
N-k Dionters (k = .75D)


Graph # 4
N-k Dionters (k= .75D)

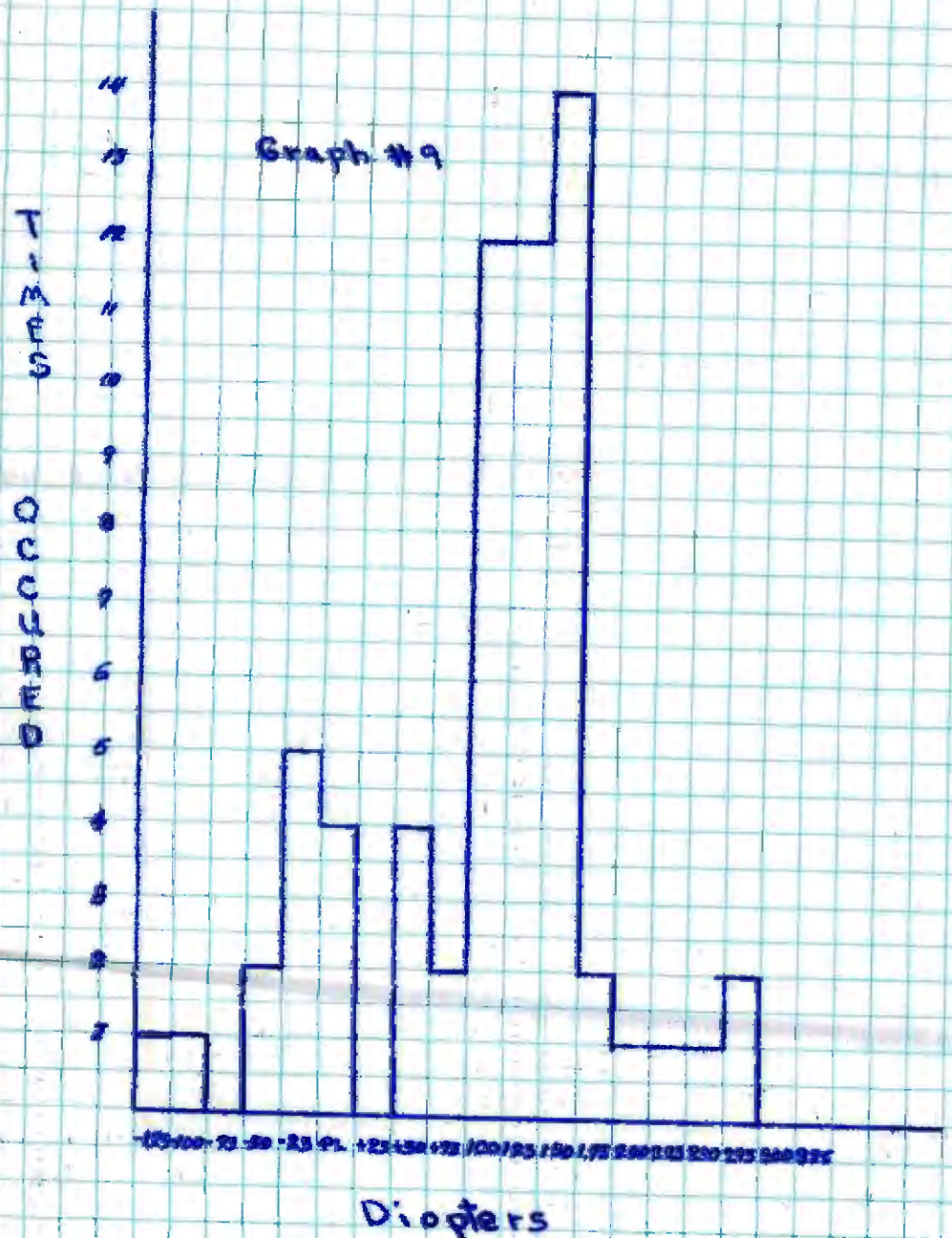

TIMES OCCURRED
Graph # 5
N-k Dionters (k = 1.00D)


Graph # 6
N-k Dionters (k = 1.00D)

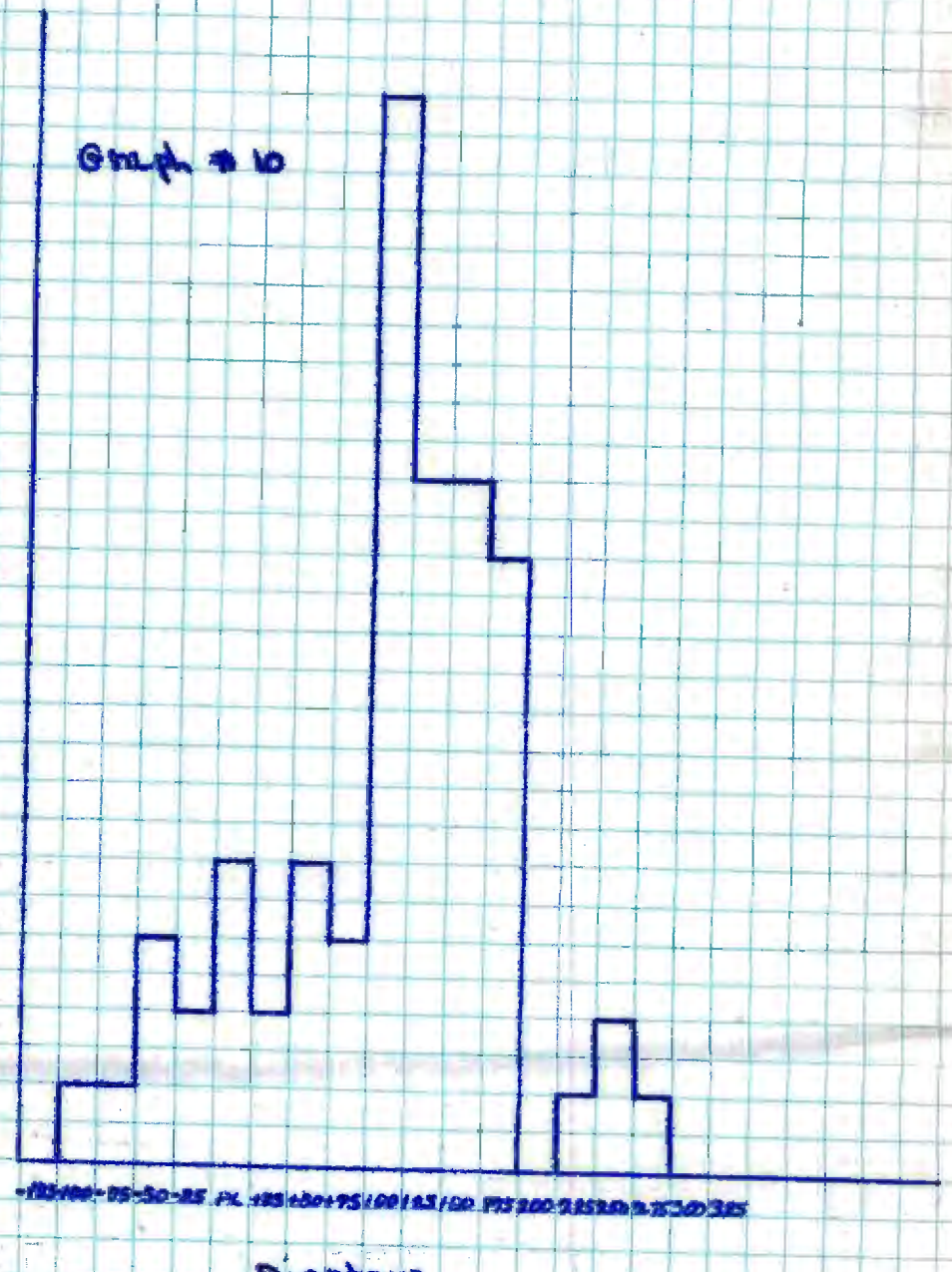

TIMES OCCURRED
Graph # 7
N-k Dionters (k = 1.25D)


Graph # 8
N-k Dionters (k = 1.25D)

Graph #9



Graph #10



Graph # 11

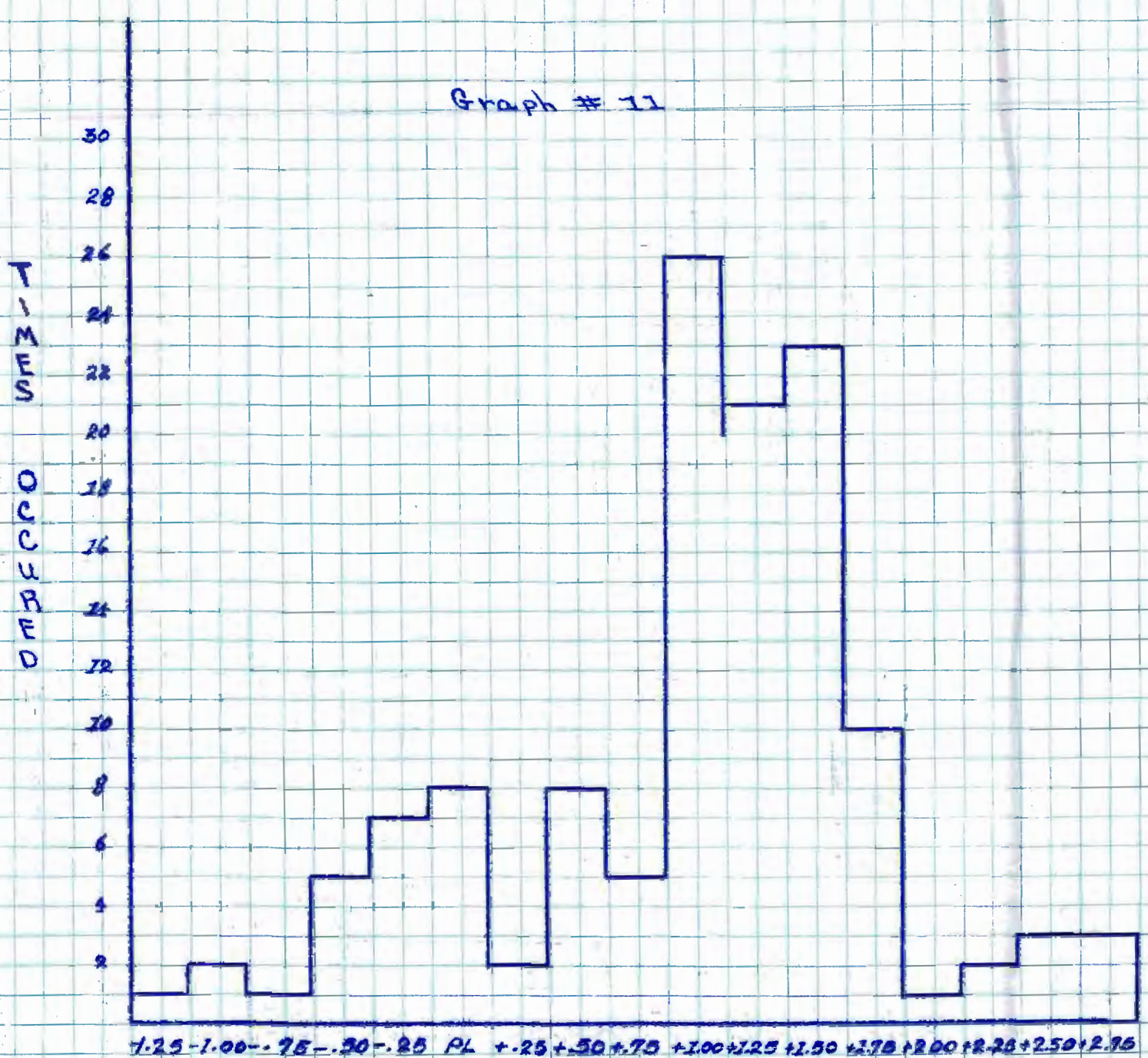

TIMES OCCURED
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
-1.25 -1.00 -.75 -.50 -.25 PL +.25 +.50 +.75 +1.00 +1.25 +1.50 +1.75 +2.00 +2.25 +2.50 +2.75
Diopters

TABLE I

GRAPH NUMBER	MEAN	MODE	MEDIAN	SIGMA	SIGMA OF DIFF.
1.	≠ 1.14	≠1.47	≠ 1.25	.73	.18
2.	≠ 1.06	≠0.88	≠ 1.00	.77	.19
3.	≠ 0.91	≠1.54	≠ 1.12	.91	.23
4.	≠ 0.94	≠1.48	≠ 1.12	.86	.22
5.	≠ 1.01	≠1.73	≠ 1.25	.63	.16
6.	≠ 1.00	≠1.00	≠ 1.00	.75	.19
7.	≠ 0.89	≠1.22	≠ 1.00	.56	.14
8.	≠ 0.95	≠1.46	≠ 1.12	.52	.13
9.	≠ 1.00	≠1.25	≠ 1.25	.43	.077
10.	≠1 .00	≠1.00	≠ 1.00	.57	.071

REFERENCES

1. The Clinical Aspects of Accommodation and Convergence

by M. W. Morgan

American Journal of Optometry 21, 303-313

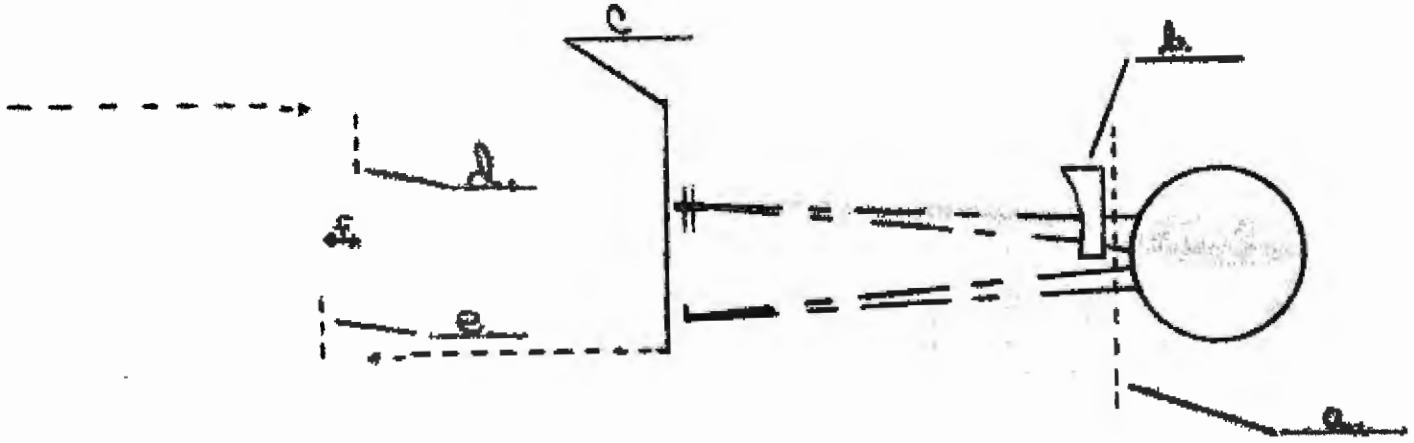
1944

In the haploscopic measurements, the lower limit of accommodation was found to be about 0.50 diopters to 1.25 diopters as averaged from 50 college students. This means that the so-called "lag of accommodation" as found by dynamic skiametry should be between the limits of 1.25 to 2.00 diopters or an average about 1.50 diopters.

Haploscopic measurements indicate, when you have 20/20 acuity that this occurs when the smallest diameter of the conoid falls about 0.50 to 0.75 diopters in front of the retina.

To sum up the above, static skiametry and subjective refraction give results about 0.75 diopters more plus than do results found with the haploscope.

Diagramatic Representation of Project Results



a. to the phorpter
b. to the split lens
c. to the 16" testing target
d. Accommodative posturing limit measured from the side of lesser plus.
e. Accommodative posturing limit measured from the side of lesser plus.
f. Difference in magnitude between accommodative posturing limit measured from the side of greater plus and the side of lesser plus

CONCLUSION

Given the same astigmatic or cross-cylinder interval, the combination of lens power makes no difference in the end point of the lag of accommodation.

Under the conditions as stated in the aforementioned procedure, we found the magnitude of inhibitory limit of the posture of accommodation during fixation at 16" to be ⌿ 1.10 minus 0.50 (for the cylindrical element of 1.00 diopter) which equals .60 diopters. Measuring from the side of lesser plus, this finding would be 0.12D greater and the finding taken from the side of greater plus would be 0.12D less.

Coming from the side of greater plus and then from the side of lesser plus, the difference in magnitude is 0.125 diopters.